MICHIGAN ENVIRONMENTAL SCIENCE BOARD
CHLORINE PANEL

MEETING SUMMARY
THURSDAY, MARCH 3, 1994
OLDS PLAZA BUILDING, 111 S. CAPITOL AVENUE
First Floor, MICHIGAN ROOM
LANSING, MI

PANEL MEMBERS PRESENT:
Dr. Lawrence Fischer, Chair
Dr. Raymond Demers
Dr. Bette Premo
Dr. Eileen van Ravenswaay

PANEL MEMBERS ABSENT:
Dr. Richard Cook

BOARD STAFF PRESENT:
Mr. Keith Harrison, Executive Director
Ms. Shirley Willis, Administrative Officer
Ms. Patricia Fay, Secretary
Mr. Alex Morese, Student Intern

I CALL TO ORDER

Dr. Lawrence Fischer called the meeting of the Michigan Environmental Science Board (MESB) Chlorine Panel to order at 1:10 p.m.

II EXECUTIVE DIRECTOR'S REPORT

Mr. Keith Harrison stated that he had provided the MESB Chlorine Panel members with correspondence from the Michigan Office of the Great Lakes regarding the availability of a 1993 video entitled "The Assault on the Male"; correspondence from Scott Paper Company regarding dioxin data from the Georgia-Pacific Muskegon, Michigan facility; correspondence from the East Michigan Environmental Action Council regarding its recent policy adoption on the release of organochlorines; an updated listing of chlorine-related articles received to date by the MESB; and correspondence from Governor Engler requesting that the MESB investigate human health concerns resulting from lead exposure. Mr. Harrison also informed the Panel that an extension to mid- to late April had been granted by the Governor's office to complete the chlorine report.

III DIRECTIVE #1: Evaluate the Scientific Basis for the International Joint Commission (IJC) Recommendations on Chlorine and Chlorinated Compounds

Dr. Fischer stated that in addition to the recommendation to sunset chlorine and chlorinated compounds, the IJC's Seventh Biennial Report listed several other recommendations on the virtual elimination of persistent toxic substances with which, in principle, the Chlorine Panel would concur. Included among these were:

1. The United States and Canada jointly develop a binational strategy for persistent toxic substances to assure coordinated action in both commerce and the receiving environment;

2. The United States and Canada adopt specific programs to achieve virtual elimination and effect zero discharge by passing the tendency to consider these concepts as hypothetical and impractical;

3. The United States and Canada give enforceable effects to the Great Lakes Water Quality Agreement principles and requirements since the shared undertakings need to be applied rigorously and in a manner that will be enforced;

4. The United States and Canada end point source discharges of persistent toxic substances to Lake Superior as a pilot approach to demonstrate the feasibility of achieving zero discharge;

5. The United States and Canada sunset PCBs and seek public acceptance for their destruction since despite agreement on their dangers, they remain in use and in storage;

6. The United States and Canada sunset DDT, dieldrin, toxaphene, mirex and hexachlorobenzene and seek an international ban on their production, use, storage and improper disposal; and

7. The United States and Canada consult with industry and other interests to alter production processes and feedstock chemicals to eliminate dioxins, furans and hexachlorobenzene as byproducts and to sunset where possible uses of lead and mercury.

Dr. Fischer asked for a discussion from the Panel Members on the IJC Seventh Biennial Report's remaining 3 recommendations. In particular, he asked the Panel members to specifically focus their comments on changes between the IJC's Sixth and Seventh Biennial Reports and on the IJC's recommendations regarding weight of evidence and

reverse onus as they apply to the IJC's final recommendation on chlorine and chlorinated substances.

Dr. Premo stated that in terms of IJC's recommendation on chlorine and chlorinated substances, there was no difference between the Sixth and Seventh reports. Drs. Demers, van Ravenswaay and Fischer, and Mr. Harrison agreed.

Mr. Harrison indicated that both reports used essentially the same weight of evidence approach to reach its conclusions regarding persistent toxic substances and persistent toxic chlorinated substances. However, both reports appear to have moved away from a more data-intensive weight of evidence approach to a much more speculative approach when discussing chlorinated substances not known to be persistent per the IJC's definition. Language such as "other chlorinated organics ... not yet separately identified, ... not yet proven to be individually toxic, and ...quite probably persistent and toxic" is used in the discussion leading up to the recommendation to sunset chlorine and chlorinated substances in both the Sixth and Seventh Biennial Reports.

Mr. Harrison indicated that he had no problem with the concept of reverse onus as it relates to new substances, however, it would appear that the IJC's recommendation would include, by its lack of specificity, not only new but also substances currently in use. Given this, non-persistent chlorine and chlorinated compounds would also need to be subjected to the concept of reverse onus. By extension, and not at all addressed by the IJC, all other compounds, chlorinated and otherwise should be also. In summary, the IJC's concept of reverse onus is a reasonable concept, but its practical value to look at ways to reduce contamination in the Great Lakes basin will be dependent on how it is applied.

Dr. Premo stated that weight of evidence to her means that sufficient information exists to scientifically describe a characteristics of a compound or a group of compounds; however, different interest groups will have different interpretations. In terms of the IJC's use of the weight of evidence approach, she indicated that the IJC probably reviewed all the same scientific peer-reviewed literature that the Panel has for the 11 persistent toxic substances. However, it is not at all clear that a similar approach was used by the IJC to reach their conclusions and recommendations about the entire class of chlorinated compounds.

Dr. Premo indicated that East Michigan Environmental Action Council (EMEAC) adopted a position statement regarding persistent toxic substances. Part 1 of the EMEAC position statement is of particular importance because it differs slightly from the IJC in saying that before a given chemical, including organochloride, should be sunset, it should first be determined whether the chemical exhibits the characteristics of a highly persistent bioaccumulative toxic chemical. If a particular organochloride exhibits such characteristics, the chemical should be subject to a policy of zero discharge. Dr. Premo indicated that it would be her interpretation from reading the position statement that the EMEAC would not be in total agreement with the IJC recommendation to treat chlorine and all chlorinated compounds as a class to be sunset.

In terms of reverse onus, Dr. Premo indicated that she agrees with the IJC concept but that the concept should also be applied to any potential substitutes which might be suggested to be used in the place of the given substance or substances to be sunset. It is not at all clear in the IJC report that this additional responsibility would be addressed.

Dr. Demers stated that he had a fair understanding of how the IJC used the weight of evidence approach for persistent toxic substances and that such an approach was not unique. The IJC weight of evidence approach represents an attempt to gain consensus among a group of people who are experts or relative experts on a given topic. The IJC approach differs somewhat from others because it is trying to predict potential public health hazards into the future that will most likely be more serious if left alone now than they would be if dealt with presently. In this context, Dr, Demers indicated that he would be in agreement with the way that the IJC has approached this topic.

Dr. Demers indicated that the concept of reverse onus is a well-accepted public health precept and, given the way that the use of the concept is phrased in the report, it would be difficult for him to disagree with the IJC's use.

Dr. Fischer stated that the IJC in both the Sixth and Seventh Biennial Reports indicated that the weight of evidence approach constituted the compiling of studies which indicate injury or the likelihood of injury in order to determine whether or not a persistent toxic substance was a problem or not. The studies were evaluated altogether rather than on a case-by-case basis. In addition, it also appears that the IJC definition would not allow for any evaluation of those studies which may show a negative or no effect impact. The IJC's use of weight of evidence would, therefore, appear to differ from the way weight of evidence was used by the IJC Virtual Elimination Task Force which attempted to look at all the evidence on a case-by-case basis.

Dr. Fischer indicated that, in general, he had no problem with the concept of reverse onus since all that it does is to place the responsibility for proof that a substance is not harmful to the environment or human health on the proponents of the chemical's production and use. The issue of concern appears to be more when, where and to what chemicals the concept is to be applied.

Dr. Fischer indicated that it would appear that the Panel does not have a problem with how the IJC has defined toxic and persistent toxic substances or with the recommendations regarding these compounds. What does appear to be a problem, however, is the apparent jump from suggesting the sunsetting of persistent toxic substances to the banning the use of an entire spectrum of compounds and a common element. There does not appear to be any evidence to suggest that the 9 chlorinated persistent toxic substances are necessarily representative of the 11,000 known chlorinated compounds in terms of such characteristics as toxicity, persistence, bioaccumulation, biological activity, solubility, hydrophobicity or number and location of chlorine atoms. There may be more scientifically sound bases to group and evaluate the chlorinated compounds such as was suggested in Dr. John Giesy's February 9,

1994 presentation to the Panel. Also, in terms of chemicals with unknown properties and effect, preliminary information could still be obtained through the use of molecular modeling to determined and evaluate the potential toxicity of the chemical compound.

Dr. Demers indicated that his understanding of the categorization process has to do with some economic realities and the fact that not every chemical can be subjected to molecular modeling or an animal toxicity study. In addition, there appears to be a number of persistent and non-persistent, highly toxic compounds which contain chlorine, perhaps more disproportionately so than any other class. So it appears to be a matter of taking a broader perspective now versus taking a more narrow perspective that may never be undertaken or completed. If the Panel agrees to the use of reverse onus concept, to apply it to something more specific than all chlorinated compounds would not be realistic at least from a public health concern.

Dr. Demers stated that the American Public Health Association had, in fact, reviewed this issue and adopted a resolution calling for a ban on chlorine and chlorinated compounds. The chlorine issue was the topic for two annual meetings and was hotly debated before the final resolution was passed.

Dr. Demers stated that the Panel also has not yet considered situations where a given chemical compound was not persistent in the environment but was persistent in terms of its effect in humans. An example of this would be methylene chlorine. Methylene chlorine is not persistent in the environment, but with high dose chronic exposure will lead to irreversible central nervous system damage. There are many other studies on chlorine in the epidemiological literature which look at acute and chronic effects.

Dr. Fischer agreed and indicated that there certainly was a need for the Panel to also be aware of exposure resulting from both the persistent and the non-persistent but nonetheless toxic chemicals.

Dr. Demers indicated that another area that the Panel needs to get a handle on is what is meant by the IJC when it calls for the development of timetables in its chlorine recommendation. The recommendation calls for the governments of the United States and Canada to consult with industry and other interests to develop timetables to sunset the use of chlorine. It does not say to sunset the use of chlorine and chlorinated compounds and then to continue from there.

Mr. Harrison indicated that it could also be read another way. For example, the recommendation says "to sunset" rather than "to consider sunsetting", which to him means that it is a foregone conclusion that chlorine and chlorinated compounds are to be sunset. The only thing left to be consulted on is how to go about it with the least disruption to society.

Dr. Fischer stated that he had talked with Gordon Durnil, IJC Co-chair, regarding clarification of the timetable concept used in the IJC's recommendation on chlorine and chlorinated substances. Mr. Durnil indicated that the IJC initially had in mind something

along the lines of 15 years but later broadened that, due to concerns raised by industry, to 15 to 30 years. In addition, Mr. Durnil indicated that the IJC, in terms of its recommendation on chlorine, wished to be out front and to serve as the catalyst for the kind of changes that they felt would be beneficial to the environment and human health. Dr. Fisher indicated that it was his opinion that Mr. Durnil was, in essence, stating the difference between the missions of the IJC and the MESB Chlorine Panel. The Panel has not been instructed to be a catalyst for change. Rather, the Panel's responsibility is simply to evaluate whether or not there is a valid scientific basis to sunset chlorine as an industrial feedstock.

Dr. Fischer stated that he also wanted the Panel to discuss the market place versus a legislative ban approach to sunsetting of chlorine which had been discussed by Dr. John Giesy at the February 9, 1994 Panel meeting. Dr. Giesy had indicated that as it becomes necessary to expend more and more money to conduct the needed tests to adequately evaluate the safety of a compound, the money issue would soon become a much greater factor in the benefit versus risk evaluation of that compound, and a deciding factor as to whether or not it would be economical to produce.

Dr. Demers expressed reservation that either approach would necessarily ensure adequate toxicological testing of the vast number of chemicals which are produced.

Dr. Fischer questioned the adequacy of the current toxicological tests currently used to evaluate waste streams. The tests which are conducted are designed to determine the ability of a given substance to cause death rather than to determine the ability of the substance to cause cancer or neurological and/or reproductive problems. In addition, such tests of lethality do not look for receptor mediated toxic responses.

Dr. Demers asked if information could be obtained regarding what percentage of new chlorinated compounds are required to be tested and for what type of toxicological assessment. Mr. Harrison indicated that he would look into the matter.

Dr. Fischer summarized the discussion to this point. He indicated that there appeared to be general consensus regarding what was meant by the reverse onus concept and that we ought not to be releasing substances that are toxic into the environment or humans. The Panel, for the most part, does not have any problem with the use of a weight of evidence approach to look at substances. The issue of contention boils down to the scientific validity of the actions by the IJC to take the evidence that currently exists for a relatively few chemicals and to extrapolate it to an entire class of chemicals.

Dr. Fischer asked the Panel to discuss the topic of substitutes for chlorine and chlorinated compounds. He indicated that the concept of reverse onus for chlorine and chlorinated compound alternatives and substitutes is, interestingly, almost non-existent throughout the IJC reports. He stated that if the Panel accepts the concept of reverse onus, then the same level of testing which is being suggested for chlorine and its compounds by the IJC would also need to be applied to any substitutes for chlorinated substances before they could be released to the environment.

Dr. Premo stated that concept of risk assessment would need to be applied when looking at chlorine substitutes. The chosen substitute would necessarily end up being the least costly and least offensive, among the possible alternatives, to the environment and human health.

Dr. van Ravenswaay agreed and indicated that another substitute could of course be society's forgoing of the products which are currently made from and with chlorine; however, she did not consider that a reasonable probability given the ubiquitous use of chlorine. There are also clearly some products which society would not want to do with out, the simplest example being pharmaceuticals.

Dr. Premo stated pharmaceuticals is one area where she could see Dr. Giesy's market demand discussion operating. For instance, society has thus far determined that the use of pharmaceuticals is of less risk than the consuming the chlorinated compounds that are within the pharmaceuticals. The cost of not using pharmaceuticals versus using them is one of the bases on which society is currently making that assessment.

Dr. Fischer indicated that pharmaceuticals were probably the easiest of all products upon which to do a risk benefit analysis. Clearly, the use of anticancer drugs is done with that in mind all the time. These drugs are very toxic compounds but are used because of the benefits, which in some situations are only slightly better than the risks. Such an analysis is not as straight forward for other products.

IV PUBLIC COMMENT AND QUESTIONS

Dr. Gregory Bond, Dow Chemical Company, commented that Dow had provided the Panel with literature of research conducted on chlorinated substances, and summaries of Dow's processes that were used to serve as checks and balances for evaluating the environmental health and safety impacts of the substances.

Dr. Demers asked about federal or state policy for toxicologic assessment of new chlorinated organic solvents. Dr. Bond responded that testing of products depends on whether the product is a pesticide or an industrial chemical. He pointed out that pesticides are heavily regulated under the Federal Insecticide, Fungicide and Rodenticide Act of 1972, and that up to 140 tests are required to be conducted in an 8 year time frame for pesticides. He estimated that an average cost of developing a new pesticide is about $60 million. Industrial chemicals and new chemical introductions are regulated under the Toxic Substances Control Act. Before a certain amount of chemical can be manufactured, a pre-manufacturing notice must be filed with the United States Environmental Protection Agency (USEPA), who determines the amount of toxicological and environmental testing that must be done on the chemical.

Dr. Fischer asked how many unknown chlorinated compounds Dr. Bond thought were in Dow's waste streams. Dr. Bond said that he did not know the answer, but in Dow's

processes they try to chemically characterize the wastes that are generated in the processes in order to determine how best to treat the waste, or to see if the waste can be recycled back into the manufacture of another product. They also evaluate the potential for human or environmental exposure to that waste, and if there is potential exposure, they would conduct some toxicity testing on the waste. Dr. Bond pointed out that the Michigan Department of Natural Resources (MDNR) requires a certain amount of testing as a part of the permitting process. Dr. Fischer commented that that the kind of toxicity testing required by the MDNR is not very sophisticated and does not get at the basis for common chronic health outcomes such as cancer, reproductive failure, etc. Dr. Bond stated that the goal with industrial chemicals in pesticides is to try and minimize the human exposure to those materials. The amount of exposure determines the amount of testing that is required.

Dr. Fischer asked about industry's level of ability to evaluate and to predict exposure. Dr. Bond stated that biomarkers are used as a measure of exposure. He indicated that a lot of time and effort is spent on monitoring in order to estimate exposure, and that the area of biomarkers, used as a measure of exposure, keeps evolving.

Dr. van Ravenswaay asked if unused chlorine stocks are recycled or is all the chlorine used up in the process. Dr. Bond responded that the unused material recycled back to a salt.

Dr. Larry Holcomb, Holcomb Environmental Services, commented on the IJC Seventh Biennial Report, stating that it is a policy-oriented rather than a scientific document that includes considerable to help back up the decisions made. He stated that the IJC looked at trends in the Great Lakes region and identified problems; and that the Panel needs to focus its attention on and differentiate between the trends and policy for chlorine as a whole. He pointed out that the IJC looked at data for some persistent chlorinated toxic substances that are known to cause problems, and then carried over that information into policy to essentially incriminate all chlorine related compounds. He indicated that the Panel also needs to look at the dose-response relationships of these chemicals to see if there is a definite and significant risk associated with a low level of exposure.

Dr. Holcomb stated that the IJC report indicates that they had looked at a list of persistent toxic bioaccumulative chlorinated, mostly chlorine based compounds such as DDT, dieldrin, PCBs and some dioxins. He suggested that the Panel go through a decision making tree to limit the scope of its investigation. The Panel should determine which chemical compounds have caused problems, and if the problems are generally recognized by scientists at large, and at what level. He pointed out that not all of the persistent toxic substances identified in the IJC report are problems at every level, and they still may have some beneficial purposes, if they are used specifically for certain purposes. He indicated that the Panel should look at the regulatory programs that are already in place and determine if they are reducing, leveling out, or at least continuing a trend to level out, the toxic impact on the environment and people. Equally important for consideration are the monitoring programs that are and will be used to identify the

trends of those chemical compounds. Dr. Holcomb stated that the Panel should also evaluate the associated risks.

Mr. Harrison asked if Dr. Holcomb knew whether the IJC Science Advisory Board had looked at and evaluated only persistent chlorinated substances or whether they also evaluated non-persistent chlorinated compounds. Dr. Holcomb stated that he believed that the evaluations were all based on toxic substances that were both persistent and bioaccumulative. Mr. Harrison stated that his concern is that he has not seen studies done on the chlorinated organics that have not been defined as persistent.

Dr. Fischer commented that the dose-response was the basis for the threshold question that he had asked of presenters at the February 9, 1994 Panel meeting. He had asked if they believed that there was a threshold for the effect of toxic substances. Dr. Giesy believed that there was but Dr. Soderstrom believed that there was not. Dr. Soderstrom indicated that he believed this because there would always be a small subset of the population who is extremely sensitive.

Dr. Fischer continued by stating that the IJC has indicated that conventional scientific concepts of dose-response and acceptable risk can no longer be defined as good scientific and management bases for defining acceptable levels of pollution. He pointed out that the IJC appears to want society to move away from relying on the traditional scientific disciplines of epidemiology and toxicology that have been used to assess adverse effects of chemicals. Dr. Fischer stated that, as a toxicologist, it is not easy to throw out the concept of dose-response because a lot of data defining the dose-response relationship would be ignored.

Ms. Tracey Easthope, Ecology Center of Ann Arbor, commented on dose-response as it relates to bioaccumulation and timing. She stated that dose amount cannot be predicted since even small amounts that go out over a long period of time will accumulate and expose humans and wildlife. She also stated that recent evidence on endocrine disruption is saying that timing may be more important than the dose. Dr. Fischer pointed out that timing is not a new concept, and that all of the information suggesting the importance of timing comes from toxicology and pharmacology.

Ms. Easthope commented on the production of dioxin from combustion, indicating that she had provided the Panel with the USEPA reassessment that says that the major source of exposure for dioxin is food, and the major source of contamination of that food is combustion of chlorinated compounds. She pointed out that the IJC had listed dioxin as one of the 11 worst compounds. In addition, there all kinds of other by-products that are also being formed, even when dioxin is not formed, that are problematic.

Dr. Premo asked Mr. Wayne Schmidt, National Wildlife Federation, about a comparison comments made in his recent correspondence to the Panel relating USEPA Director Dr. Linda Birnbaum's, estimate that humans, taken as a group, are exposed to approximately 1 to 3 pg/kg/day of dioxin-like compounds and Dr. Mabley's study which demonstrated demasculization in male rats who had a single dose at 64 ng/kg/day. Dr.

Premo indicated that that was not really a fair comparison since 64 ng/kg/day is 64,000 pg/kg/day, which would be equivalent to 175 years of exposure in a human being at the current exposure level estimated by the USEPA.

Mr. Schmidt stated that Dr. Birnbaum has repeatedly asserted that the 1 to 3 pg/kg/day exposure level is of concern to the general population.

Dr. Fischer commented that Dr. Birnbaum's assertion has met with considerable controversy in scientific circles. It is one of those cases where a good scientist can produce good numbers, but the interpretation of those numbers represents scientific judgement which is debatable.

Mr. Schmidt stated that the IJC's recommendations are credible and do provide a reasonable alternative approach to dealing with a class of chemicals that is particularly troublesome. He stated that the most outspoken critics do not offer a viable alternative, a constructive approach.

Dr. Demers commented that a differentiation needs to be made between average intakes or exposures and the variation of exposure in humans, because if the average is 50 pg/kg/day, then somebody may be receiving 0 to 10 pg/kg/day and someone else may be receiving 300 pg/kg/day. As a public health issue, it is necessary to look at the variation and not look at the population-wide average.
In regards to dose-response, Dr. Demers stated that his scientific view is that dose-response is a necessary ingredient to looking at causation. He pointed out that if it does not exist, it does not necessarily mean there is not a causal relationship. Dose-response is independent of threshold limit.

Dr. Michael Pcolinski, Michigan Chemical Council, stated that the idea that there are no chemical processes involving chlorine that do not result in the formation of dioxin is incorrect. The characteristic aromatic ring structure of dioxin is not produced in the manufacture of the herbicide atrazine, for example, when a carbon/chlorine bond is produced. He also pointed out that in a recent communication, Dr. Birnbaum indicated that she did not think the carbon chlorine bond was producing endocrine disruption, but rather, the coplanarity of two aromatic or benzene rings within the structure, even in non-chlorine molecules. He said he would forward the publication containing the information to the Panel. The banning of chlorine will not solve the problem of endocrine disruption if it is not chlorine that is causing the problem.

Dr. Pcolinski also discussed his own research, which will soon be published in the *Journal of Medical Products*. He and his co-researchers isolated chloro-organics from *Solidago spp.*, a species of goldenrod. These chloro-organics occur in 164 species of *Solidago* in North America, as well as in *Silphium clerodane* and *Silphium labdane diterpenes*. These compounds are produced in significant amounts in nature. The human body and all organisms have mechanisms that adapt to their presence.

V DIRECTIVE 2. Evaluate the Adequacy of Michigan's Chlorine Regulations

Dr. Fischer indicated that due to time constraints, the Panel would not be able to discuss the second directive at this meeting. Such a discussion will need to take place at a future meeting. The Panel has already received a synopsis of the current state and federal regulations which have either a direct or indirect impact on the use of chlorine and chlorinated compounds. It will be necessary for the Panel to decide how adequate or effective these regulations are in protecting human health and the environment.

Dr. Premo asked whether all the specific compounds outlined in the IJC report were regulated in Michigan. Mr. Harrison responded that they were.

Dr. Premo also expressed concern about chlorine production in other parts of the world that might affect Michigan's environment and whether the Panel needed to address atmospheric deposition. Drs. Premo and van Ravenswaay agreed that there should be such a discussion, since there is evidence that Michigan is being exposed to some of these compounds via the atmosphere.

Dr. Demers asked whether other states were conducting formal inquiries on the IJC report recommendations. Mr. Harrison responded that no other states were involved in such a study, but that the USEPA is planning a chlorine study in the near future.

VI PANEL ASSIGNMENTS

Dr. Fischer indicated that the Panel members had already been provided with a copy of the draft outline for the report and the specific sections of the report for which they will be responsible (see Attachment 1).

Dr. van Ravenswaay suggested that two topics be added to the existing report outline - a discussion on alternatives to the major sources of chlorine for her portion of the report and a discussion on atmospheric deposition and environmental fate to Dr. Cook's section on chlorine chemistry.

VII NEXT MEETING DATE

The next meeting date of the MESB Chlorine Panel was not established at the March 3, 1994 meeting (The date for the next meeting was subsequently established for March 30, 1994).

VIII ADJOURNMENT

The meeting was adjourned at 4:25 p.m.

Keith G. Harrison, M.A., R.S., Cert. Ecol.
MESB Executive Director